

Chemistry and Metallurgy in India

From Ancient Alchemy to Modern
Science

From Alchemy to Chemistry

- Modern chemistry evolved from Alchemy (1300-1600 C.E.)
- Began in Egypt; Greeks merged knowledge
- Arabs named it "al-Khemia" - origin of word
- Two pursuits: Philosopher's Stone & Elixir



Ancient Indian Chemistry (Rasāyana Śāstra)

- Also called: Rasatantra, Rasakriyā, Rasavidyā
- Included metallurgy, medicine, cosmetics, glass, dyes
- Vedic texts (Yajurveda, Rgveda) mention metal extraction
- Applied knowledge across various walks of life

Early Chemical Techniques: Harappan

- Mass production pottery - earliest chemistry
- Baked bricks with gypsum cement
- Glazed pottery from Mohenjodaro
- Faience from partially melted quartz

Glass Making in Ancient India

- Evidence from 800-500 B.C.E.
- Glass beads at Harappa (1700 B.C.E.)
- 200 years before Egypt!
- Metallic oxides for superior coloring

Paints, Dyes & Cosmetics

- Ajanta & Ellora paintings remain fresh
- Dyes from turmeric, sunflower, madder, lac
- Cosmetics in Vārāhamihira's texts
- Seasonal formulations in Āyurveda

Advanced Chemicals in Ancient India

- Sulfuric and Nitric acid preparation (Caraka Samhitā)
- Metal oxides of copper, tin, zinc; metal sulfates
- Gunpowder mixture described in Rasopaniṣada
- Mercury compounds and metal extraction techniques

Atomic Theory in Ancient India

- Kaṇāda (600 B.C.E.) formulated atomic theory (Anu)
- 2500 years before John Dalton!
- Atoms: eternal, indestructible, spherical, in motion
- Caraka Samhitā describes nanotechnology in bhasma preparation

Copper Metallurgy: Advanced Expertise

- Dates back to Chalcolithic culture
- Harappans achieved 98% copper purity
- Aravalli Hills primary copper source
- Evidence of smelting at Rajpur Dariba (2nd millennium B.C.E.)

Iron and Steel: Wootz Steel

- Iron furnaces in Ganges Valley
- Agaria tribes perfected smelting
- Wootz steel: high carbon content
- Exported as "Damascus Steel"

The Iron Pillar: No Rust for 1,600 Years

- High purity wrought iron (99%+)
- Protective layer of iron phosphate
- Minimal impurities prevented corrosion
- Advanced metallurgical knowledge

Zinc: World's First Distillation

- India mastered zinc distillation first
- Zawar mines in Rajasthan
- Downward distillation in retorts
- Two-chamber cooling design

Gold & Silver: Precious Metal Expertise

- Deepest ancient gold mines in Maski, Karnataka
- Ornaments found at Mohenjodaro (3000 B.C.E.)
- Alluvial placer deposits from river Sindhu
- Kautilya's Arthaśāstra describes refining processes

Paper and Ink: Ancient Documentation

- Evidence from 5th-8th century C.E. manuscripts
- Ink pot found at Taxila (4th century C.E.)
- Black ink from nuts, myrobalans, lamp black, sugar
- Tannin solution with ferric salts for durability

Ancient Knowledge, Modern Applications

Indian metallurgical and chemical traditions demonstrate:

- Advanced technical expertise and innovation
- Systematic scientific methods and documentation
- Relevance to modern nanotechnology and materials science